Fig.1

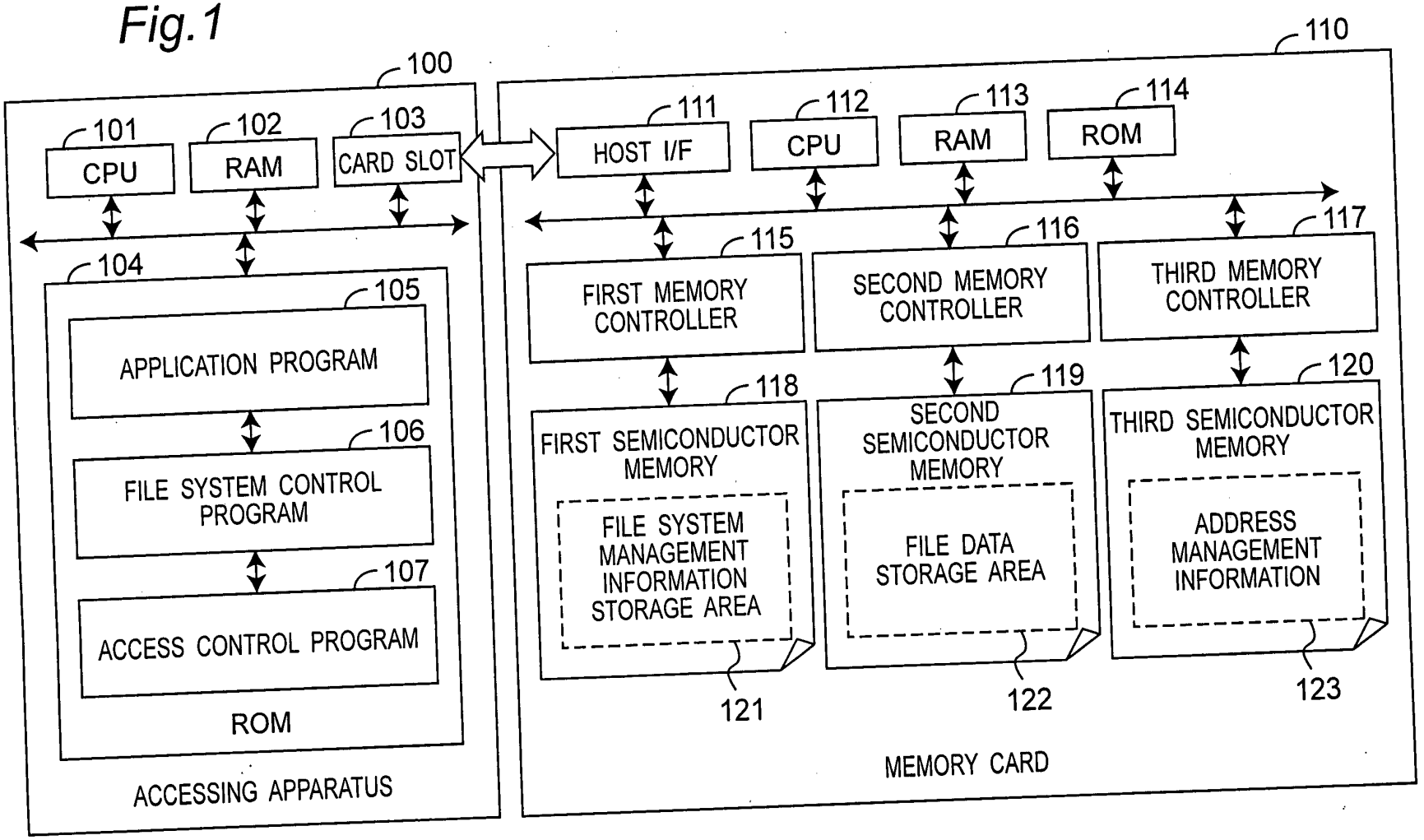
100
101
CPU
102
RAM
103
CARD SLOT
104
105
APPLICATION PROGRAM
106
FILE SYSTEM CONTROL PROGRAM
107
ACCESS CONTROL PROGRAM
ROM
ACCESSING APPARATUS
110
111
HOST I/F
112
CPU
113
RAM
114
ROM
115
FIRST MEMORY CONTROLLER
116
SECOND MEMORY CONTROLLER
117
THIRD MEMORY CONTROLLER
118
FIRST SEMICONDUCTOR MEMORY
FILE SYSTEM MANAGEMENT INFORMATION STORAGE AREA
119
SECOND SEMICONDUCTOR MEMORY
FILE DATA STORAGE AREA
120
THIRD SEMICONDUCTOR MEMORY
ADDRESS MANAGEMENT INFORMATION
121
122
123
MEMORY CARD

Fig.2

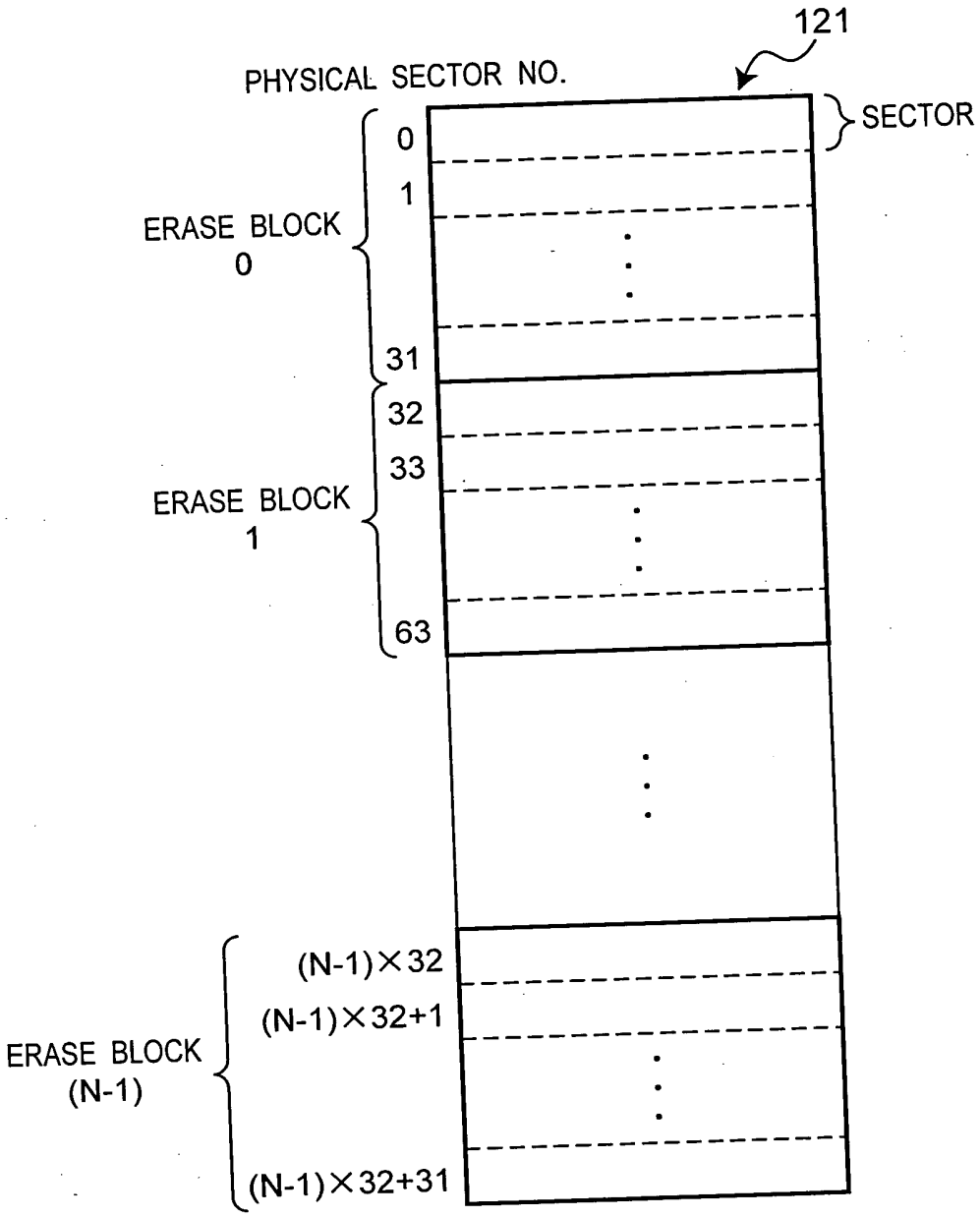
121
PHYSICAL SECTOR NO.
SECTOR
0
1
31
32
33
63
ERASE BLOCK 0
ERASE BLOCK 1
(N-1)×32
(N-1)×32+1
(N-1)×32+31
ERASE BLOCK (N-1)

Fig.3

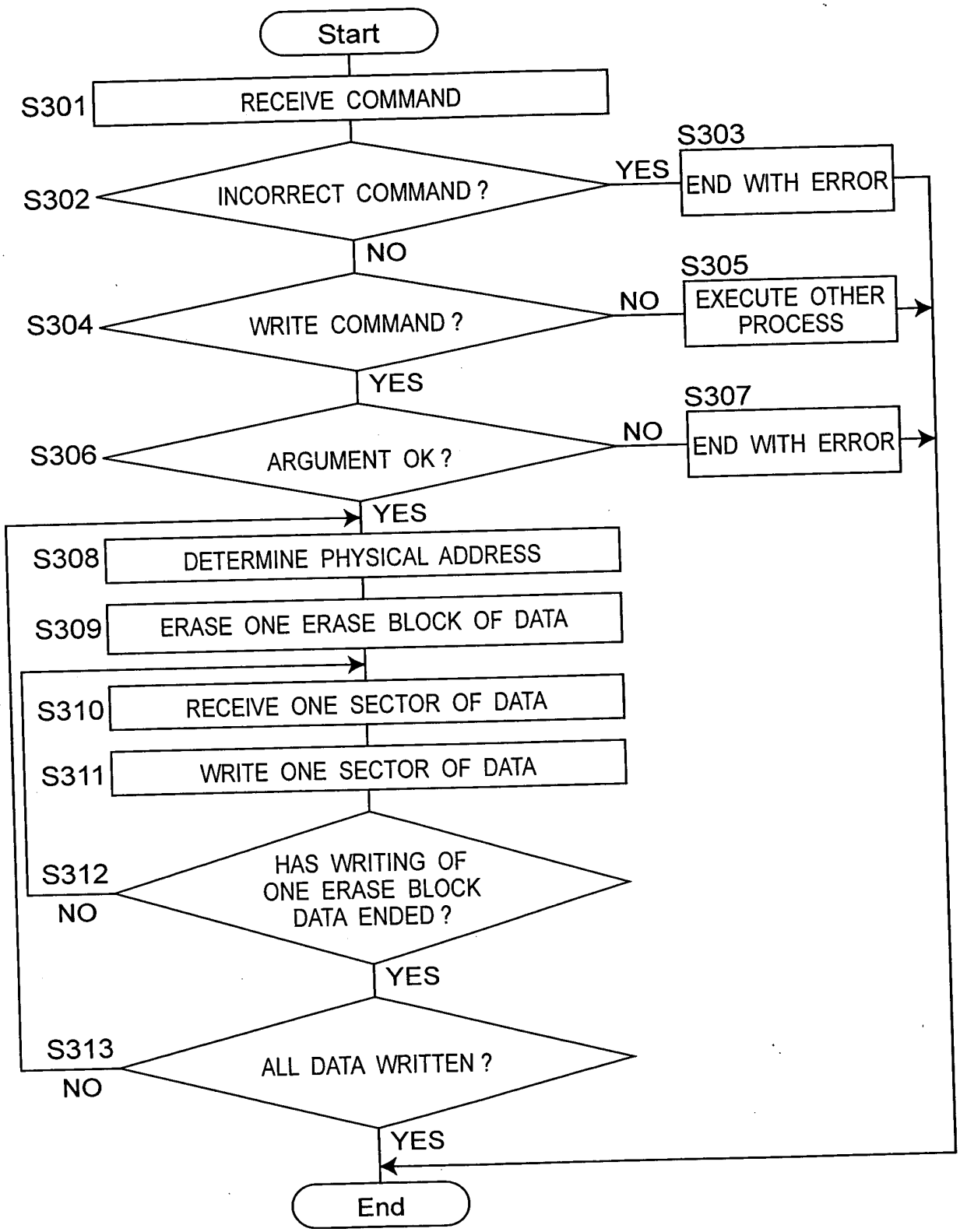
Start
S301
RECEIVE COMMAND
S302
INCORRECT COMMAND ?
YES
S303
END WITH ERROR
NO
S304
WRITE COMMAND ?
NO
S305
EXECUTE OTHER PROCESS
YES
S306
ARGUMENT OK ?
NO
S307
END WITH ERROR
YES
S308
DETERMINE PHYSICAL ADDRESS
S309
ERASE ONE ERASE BLOCK OF DATA
S310
RECEIVE ONE SECTOR OF DATA
S311
WRITE ONE SECTOR OF DATA
S312
HAS WRITING OF ONE ERASE BLOCK DATA ENDED ?
NO
YES
S313
ALL DATA WRITTEN ?
NO
YES
End

Fig.4

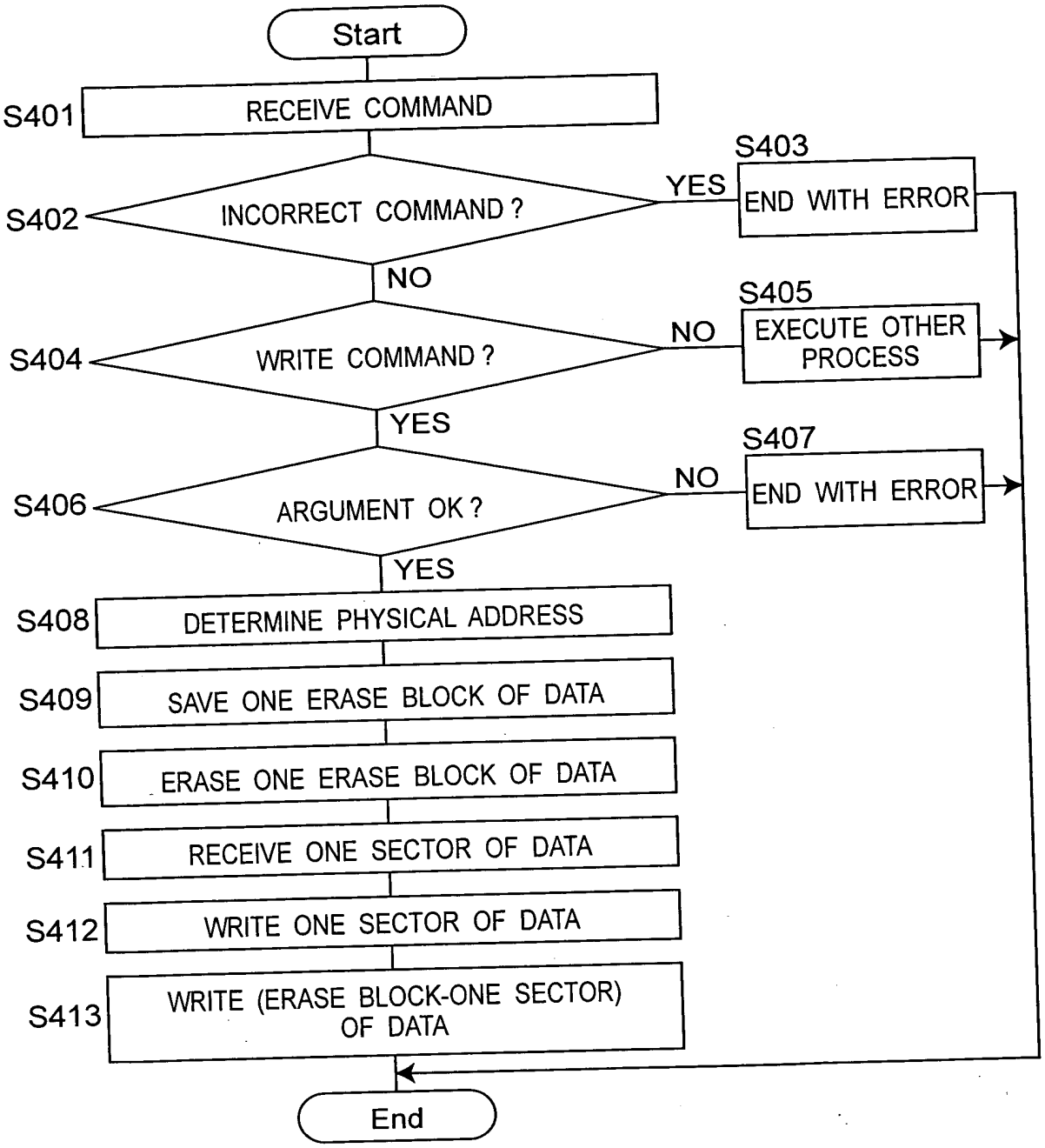
Start
S401
RECEIVE COMMAND
S402
INCORRECT COMMAND ?
YES
S403
END WITH ERROR
NO
S404
WRITE COMMAND ?
NO
S405
EXECUTE OTHER PROCESS
YES
S406
ARGUMENT OK ?
NO
S407
END WITH ERROR
YES
S408
DETERMINE PHYSICAL ADDRESS
S409
SAVE ONE ERASE BLOCK OF DATA
S410
ERASE ONE ERASE BLOCK OF DATA
S411
RECEIVE ONE SECTOR OF DATA
S412
WRITE ONE SECTOR OF DATA
S413
WRITE (ERASE BLOCK-ONE SECTOR) OF DATA
End

Fig. 5

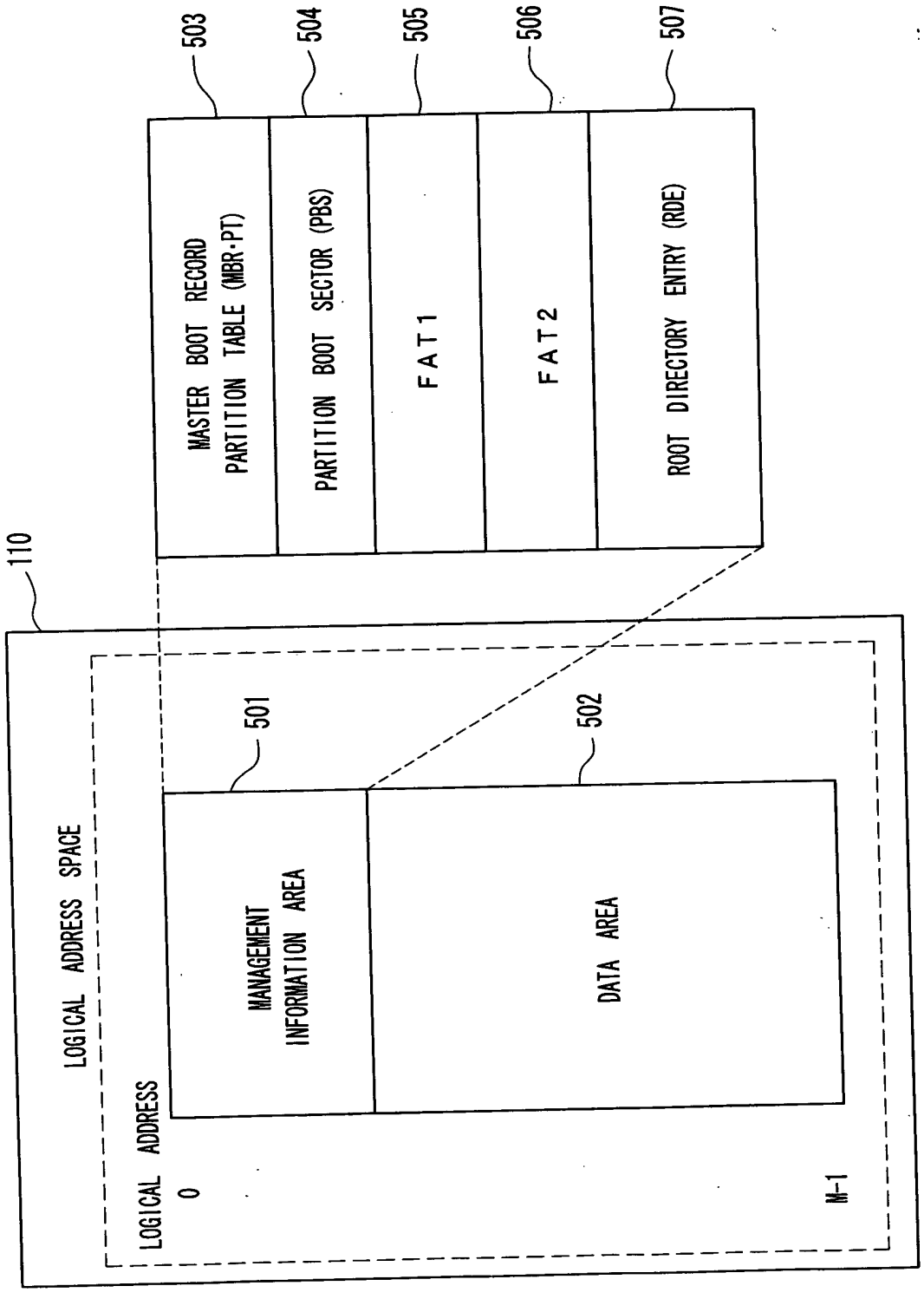
110
LOGICAL ADDRESS SPACE
LOGICAL ADDRESS
0
M-1
501
MANAGEMENT INFORMATION AREA
502
DATA AREA
503
MASTER BOOT RECORD PARTITION TABLE (MBR·PT)
504
PARTITION BOOT SECTOR (PBS)
505
FAT1
506
FAT2
507
ROOT DIRECTORY ENTRY (RDE)

Fig.6

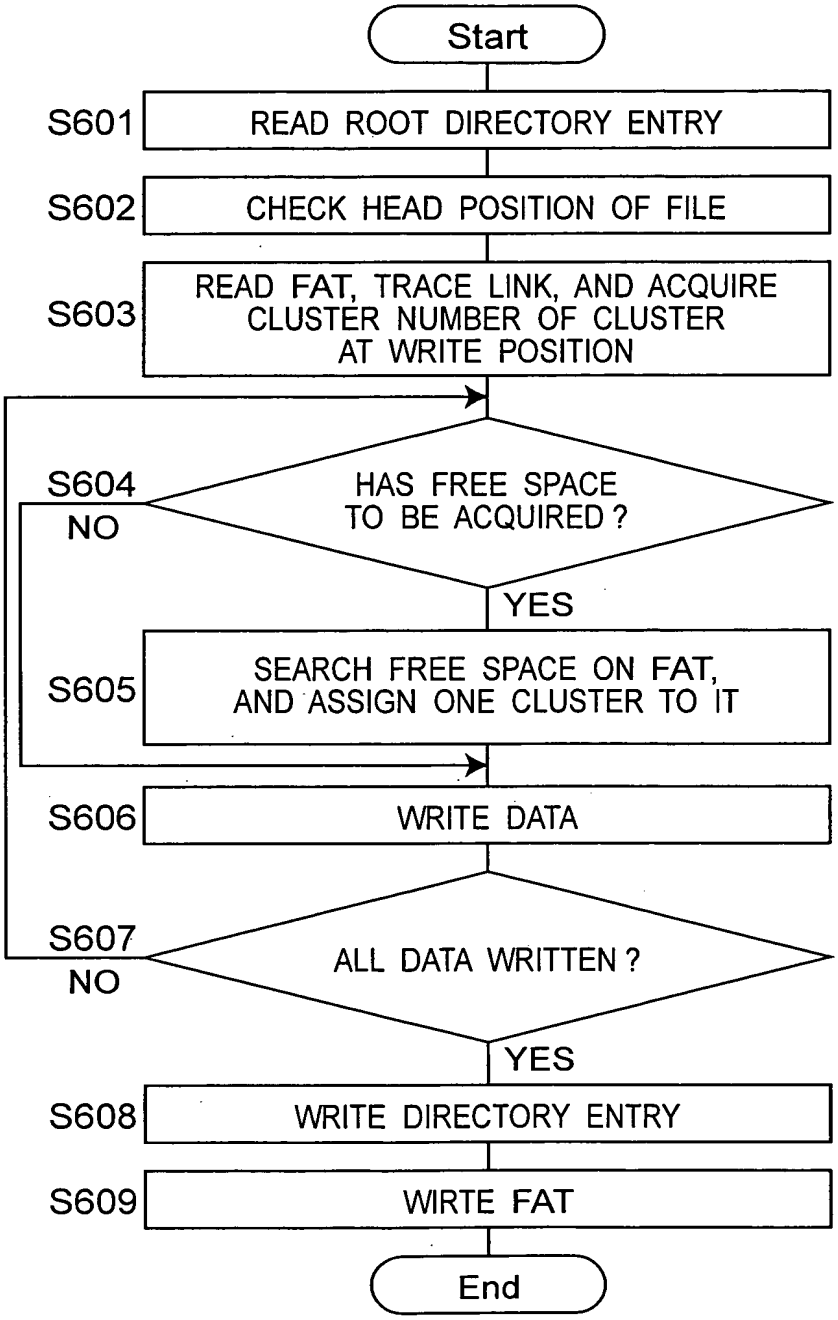
Start
S601
READ ROOT DIRECTORY ENTRY
S602
CHECK HEAD POSITION OF FILE
S603
READ FAT, TRACE LINK, AND ACQUIRE CLUSTER NUMBER OF CLUSTER AT WRITE POSITION
S604
HAS FREE SPACE TO BE ACQUIRED ?
NO
YES
S605
SEARCH FREE SPACE ON FAT, AND ASSIGN ONE CLUSTER TO IT
S606
WRITE DATA
S607
ALL DATA WRITTEN ?
NO
YES
S608
WRITE DIRECTORY ENTRY
S609
WIRTE FAT
End

Fig.7A

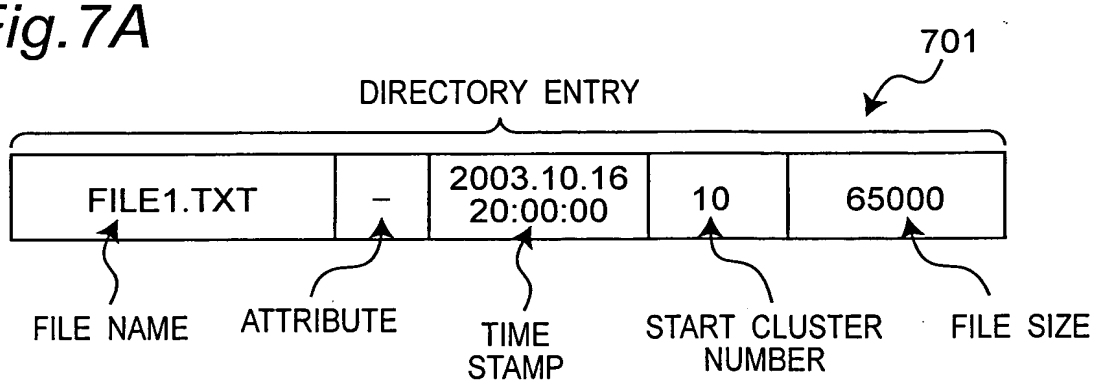

Fig.7B

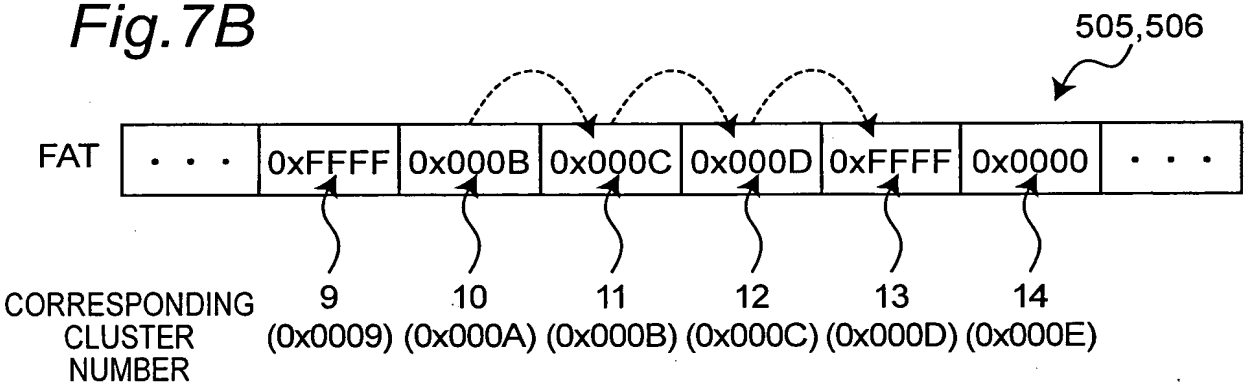

Fig.7C

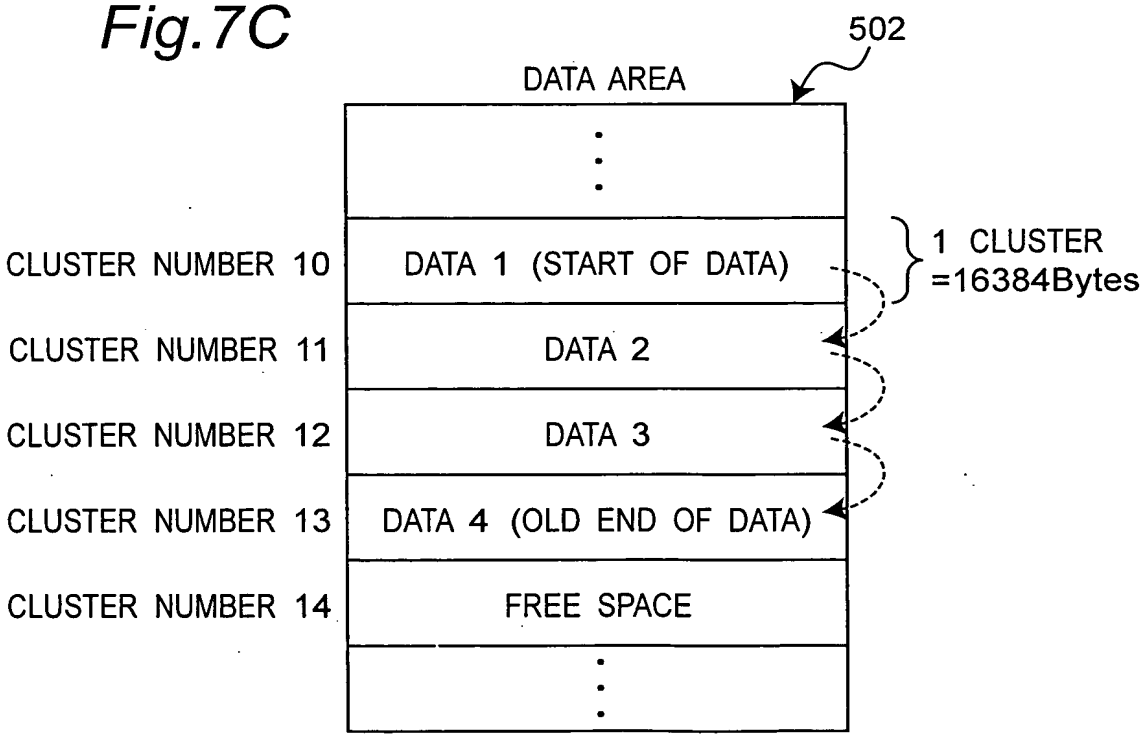

Fig.8A

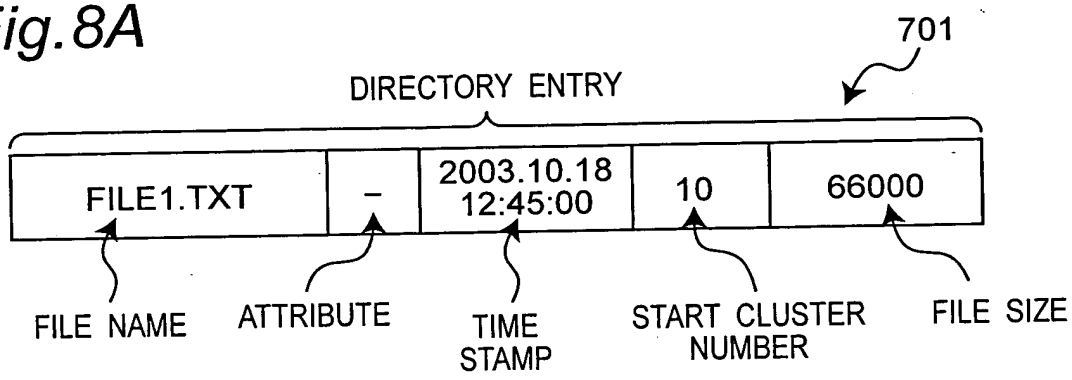

Fig.8B

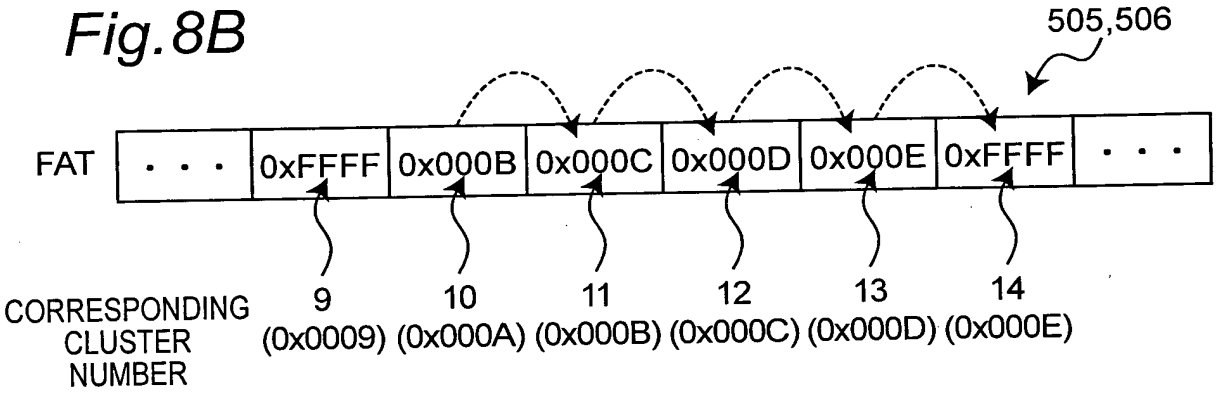

Fig.8C

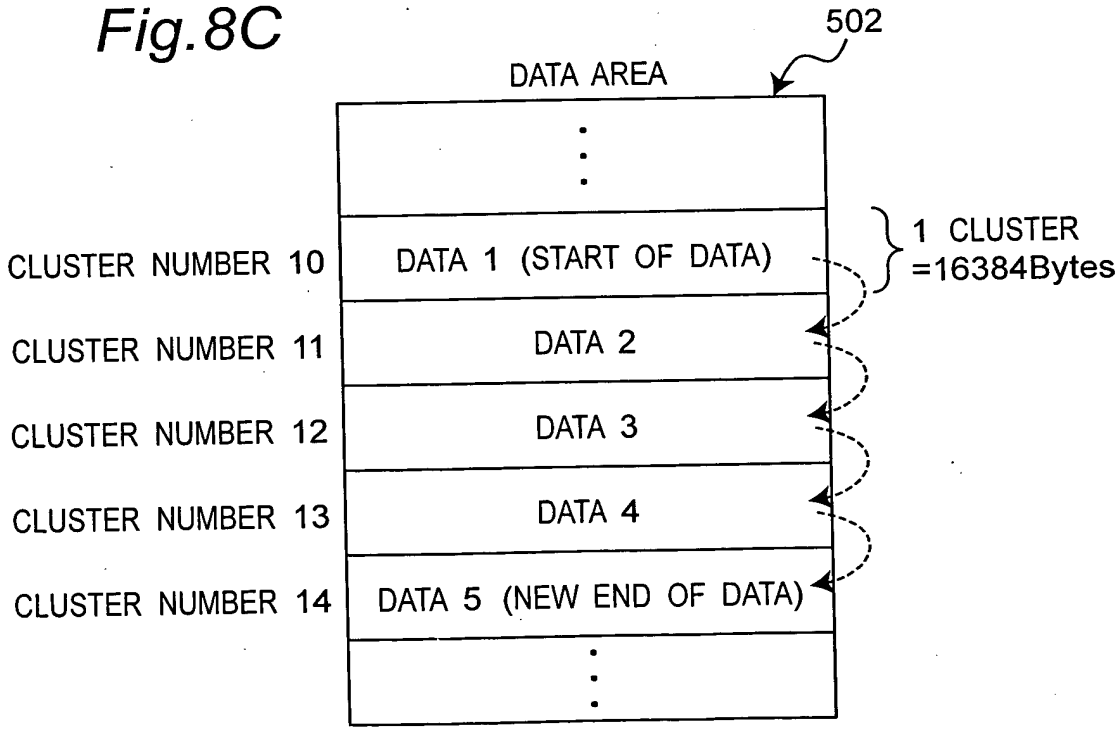

Fig.9

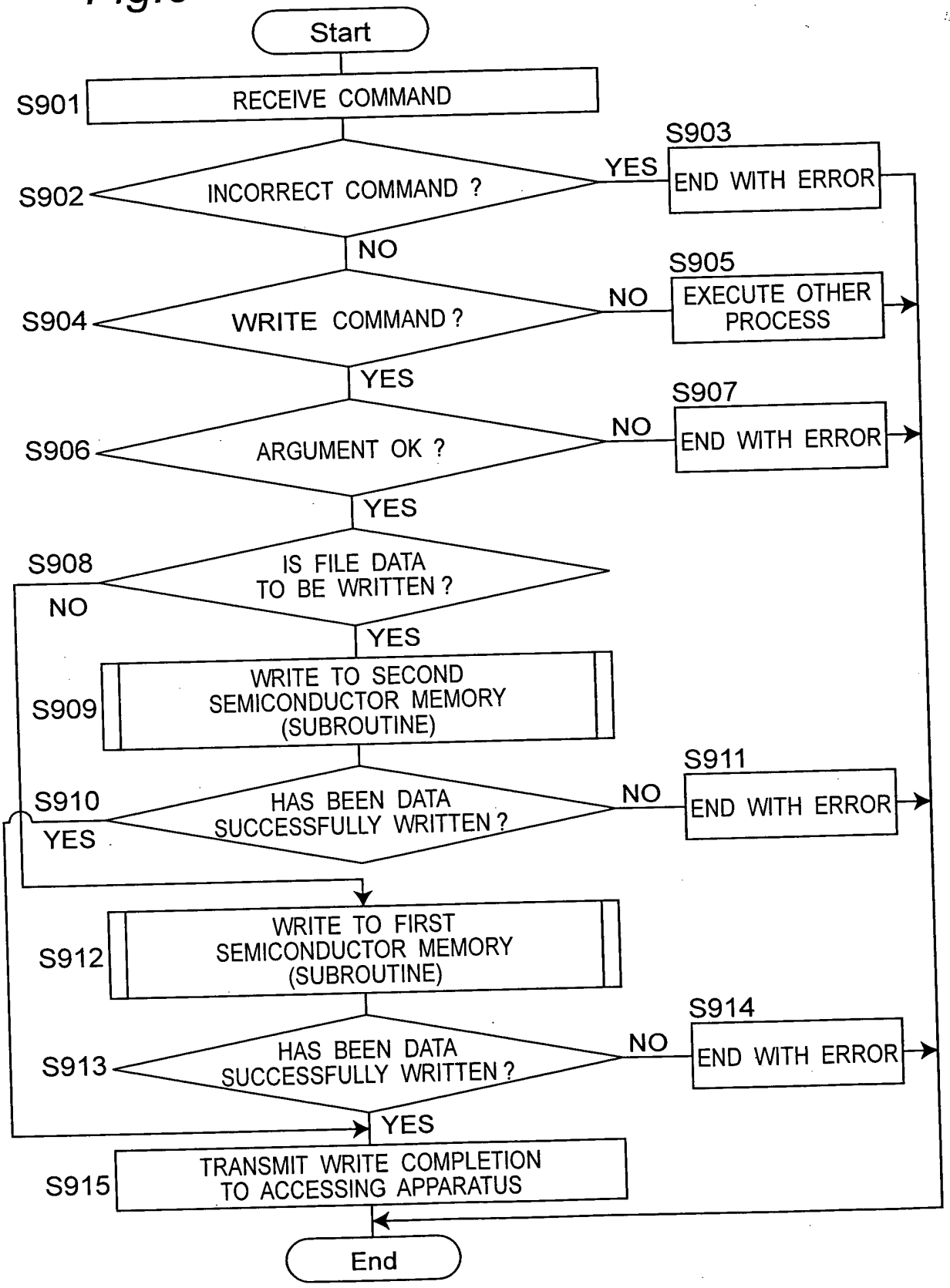
Start
S901
RECEIVE COMMAND
S902
INCORRECT COMMAND ?
YES
S903
END WITH ERROR
NO
S904
WRITE COMMAND ?
NO
S905
EXECUTE OTHER PROCESS
YES
S906
ARGUMENT OK ?
NO
S907
END WITH ERROR
YES
S908
IS FILE DATA TO BE WRITTEN ?
NO
YES
S909
WRITE TO SECOND SEMICONDUCTOR MEMORY (SUBROUTINE)
S910
HAS BEEN DATA SUCCESSFULLY WRITTEN ?
NO
S911
END WITH ERROR
YES
S912
WRITE TO FIRST SEMICONDUCTOR MEMORY (SUBROUTINE)
S913
HAS BEEN DATA SUCCESSFULLY WRITTEN ?
NO
S914
END WITH ERROR
YES
S915
TRANSMIT WRITE COMPLETION TO ACCESSING APPARATUS
End

Fig. 10

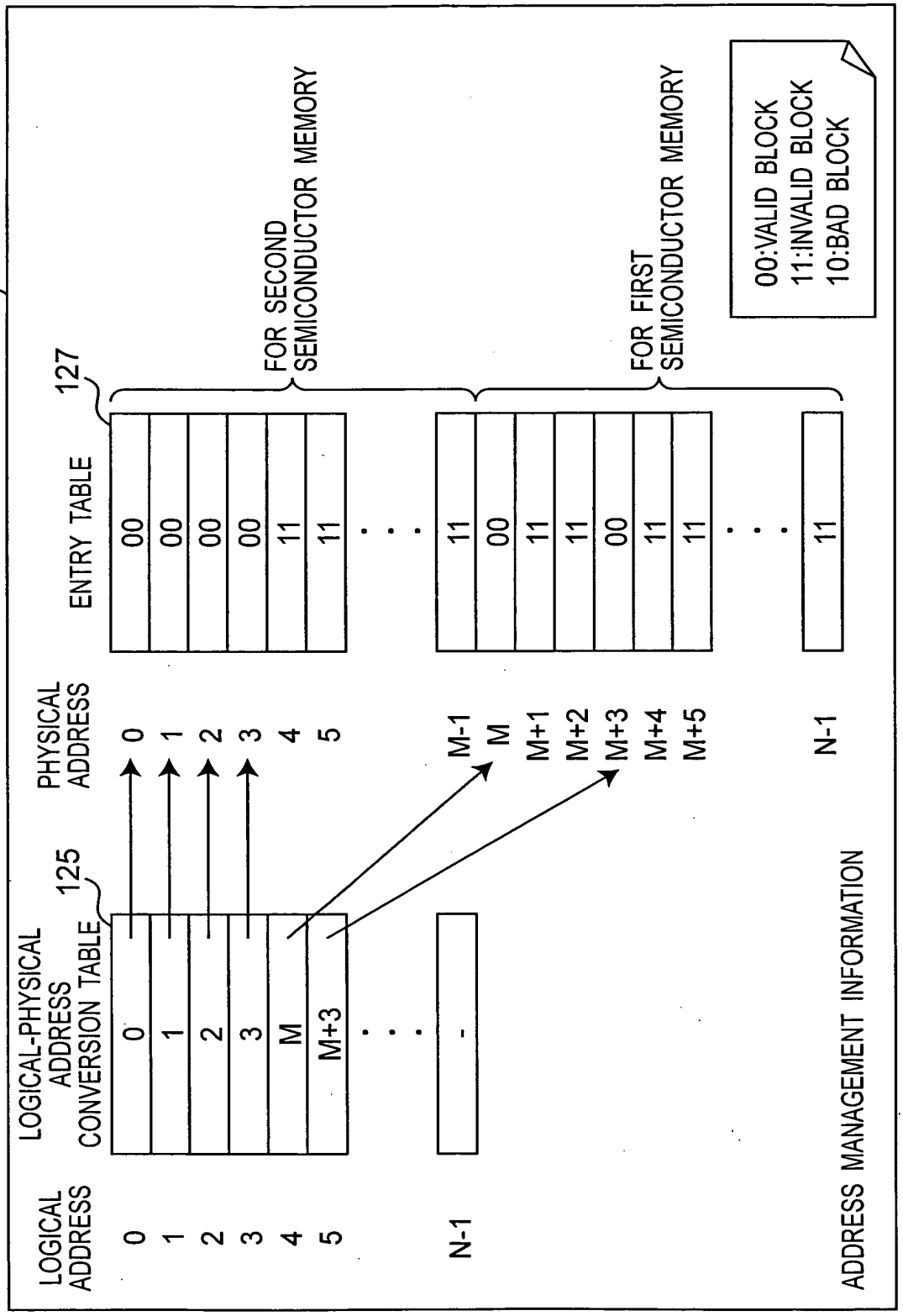
123
ADDRESS MANAGEMENT INFORMATION
LOGICAL ADDRESS
0
1
2
3
4
5
N-1
LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE
125
0
1
2
3
M
M+3
-
PHYSICAL ADDRESS
0
1
2
3
4
5
M-1
M
M+1
M+2
M+3
M+4
M+5
N-1
ENTRY TABLE
127
00
00
00
00
11
11
11
00
11
11
00
11
11
11
FOR SECOND SEMICONDUCTOR MEMORY
FOR FIRST SEMICONDUCTOR MEMORY
00:VALID BLOCK
11:INVALID BLOCK
10:BAD BLOCK

Fig.11

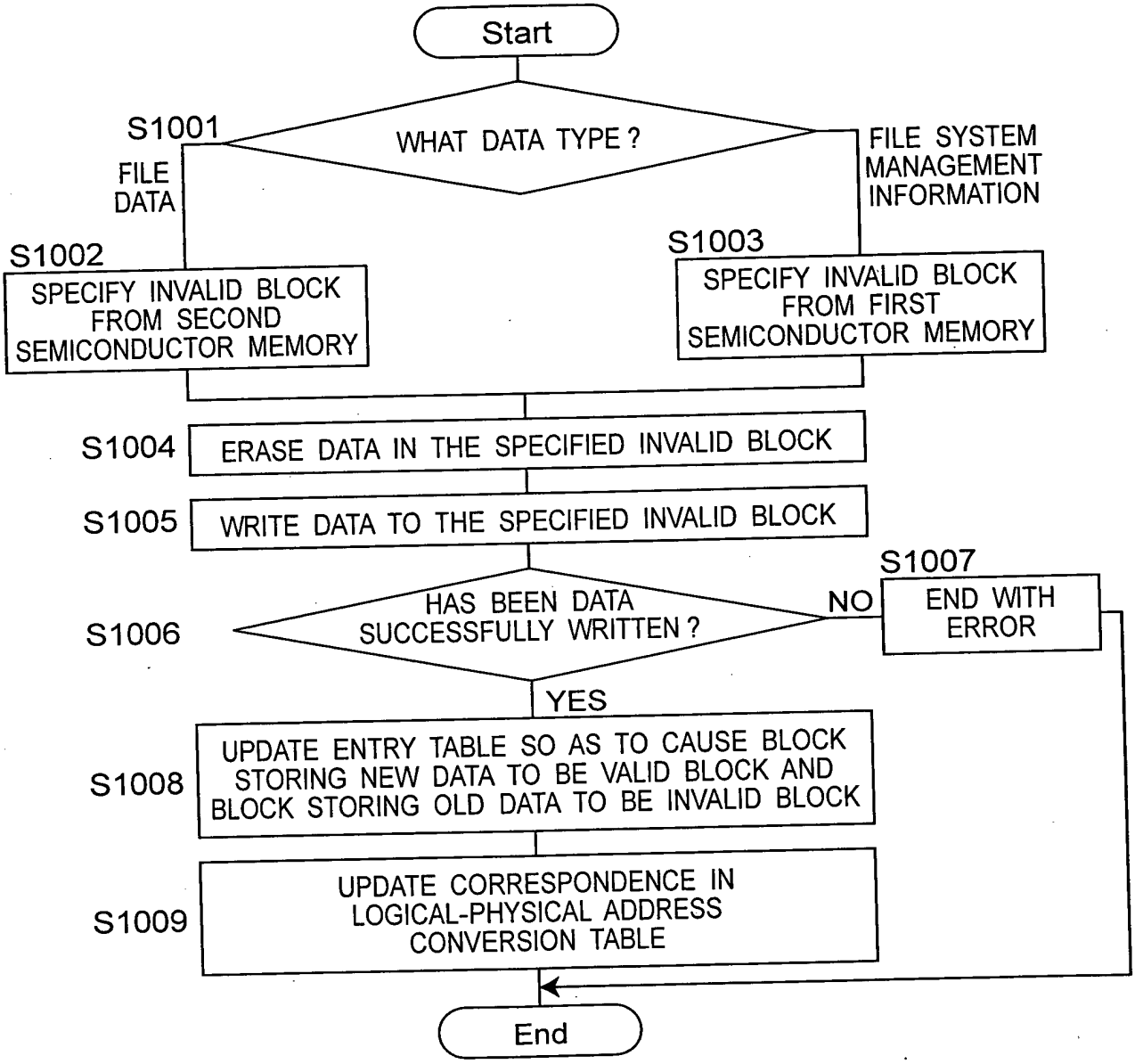
Start
S1001
WHAT DATA TYPE ?
FILE DATA
FILE SYSTEM MANAGEMENT INFORMATION
S1002
SPECIFY INVALID BLOCK FROM SECOND SEMICONDUCTOR MEMORY
S1003
SPECIFY INVALID BLOCK FROM FIRST SEMICONDUCTOR MEMORY
S1004
ERASE DATA IN THE SPECIFIED INVALID BLOCK
S1005
WRITE DATA TO THE SPECIFIED INVALID BLOCK
S1006
HAS BEEN DATA SUCCESSFULLY WRITTEN ?
NO
S1007
END WITH ERROR
YES
S1008
UPDATE ENTRY TABLE SO AS TO CAUSE BLOCK STORING NEW DATA TO BE VALID BLOCK AND BLOCK STORING OLD DATA TO BE INVALID BLOCK
S1009
UPDATE CORRESPONDENCE IN LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE
End

Fig.12

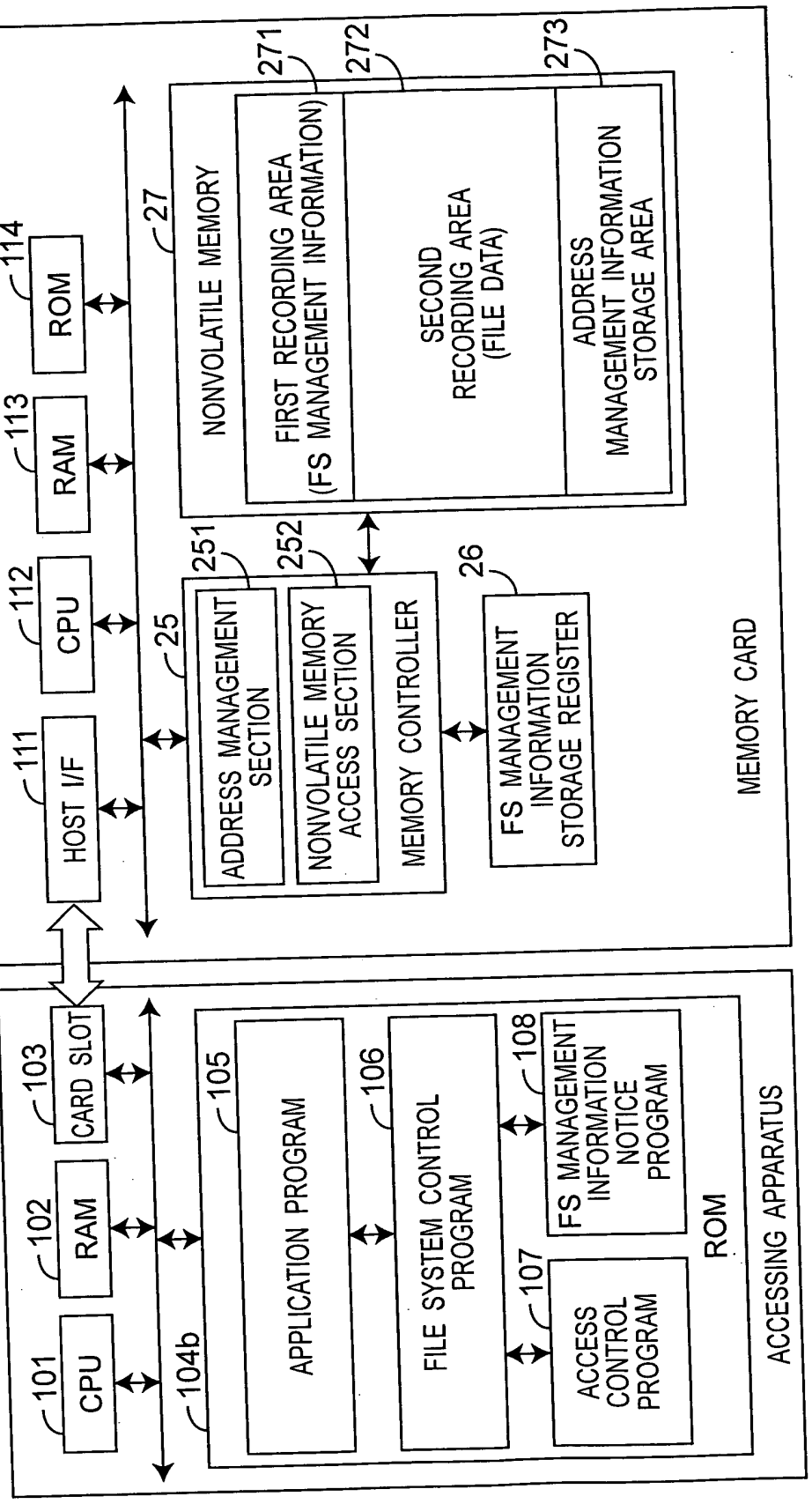
100b
ACCESSING APPARATUS
CPU
101
RAM
102
CARD SLOT
103
104b
ROM
APPLICATION PROGRAM
105
FILE SYSTEM CONTROL PROGRAM
106
ACCESS CONTROL PROGRAM
107
FS MANAGEMENT INFORMATION NOTICE PROGRAM
108
110b
MEMORY CARD
HOST I/F
111
CPU
112
RAM
113
ROM
114
27
25
ADDRESS MANAGEMENT SECTION
251
NONVOLATILE MEMORY ACCESS SECTION
252
MEMORY CONTROLLER
26
FS MANAGEMENT INFORMATION STORAGE REGISTER
NONVOLATILE MEMORY
FIRST RECORDING AREA (FS MANAGEMENT INFORMATION)
271
SECOND RECORDING AREA (FILE DATA)
272
ADDRESS MANAGEMENT INFORMATION STORAGE AREA
273

Fig. 13

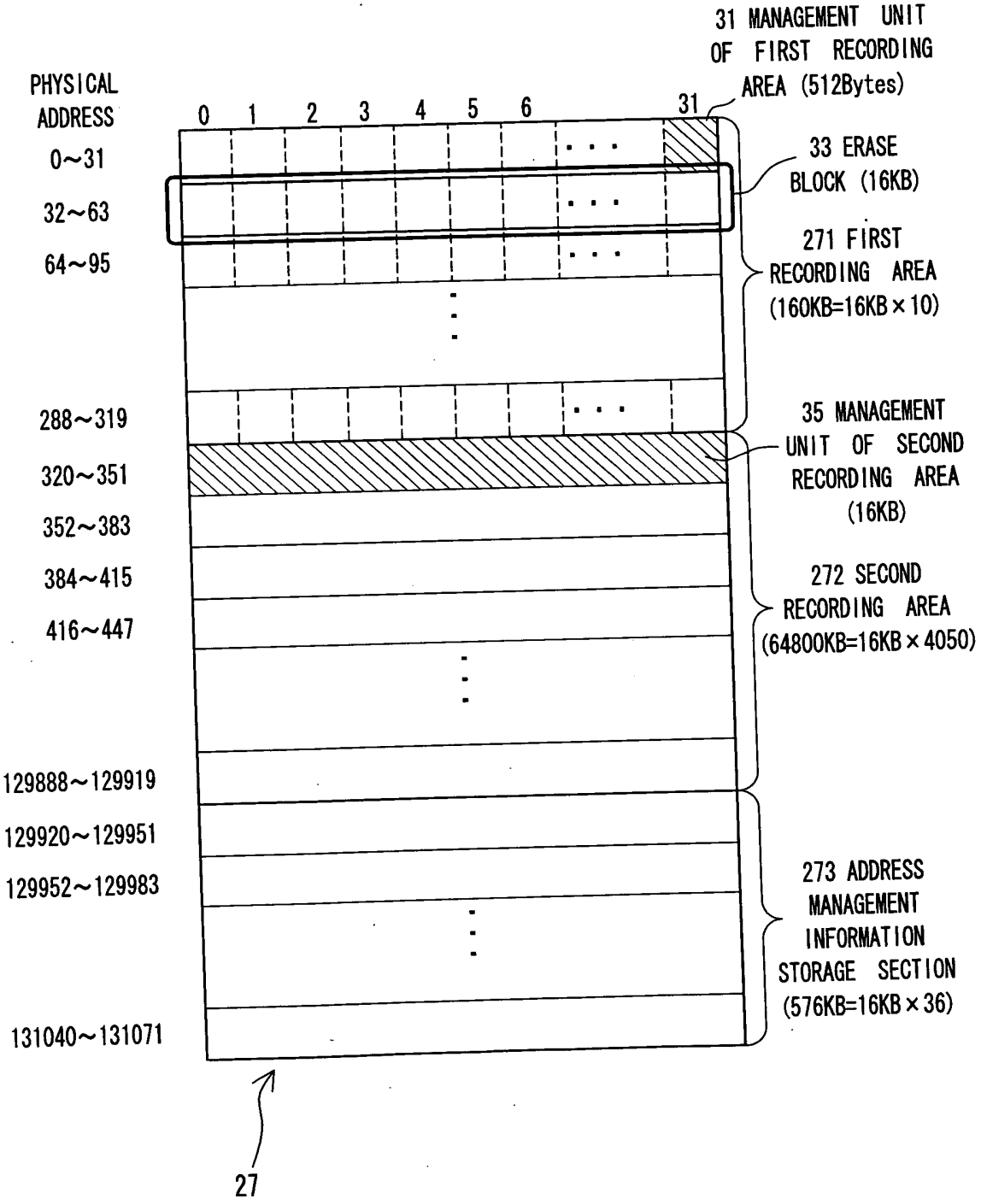
31 MANAGEMENT UNIT OF FIRST RECORDING AREA (512Bytes)
PHYSICAL ADDRESS
0 1 2 3 4 5 6 31
0~31
32~63
64~95
288~319
320~351
352~383
384~415
416~447
129888~129919
129920~129951
129952~129983
131040~131071
33 ERASE BLOCK (16KB)
271 FIRST RECORDING AREA (160KB=16KB×10)
35 MANAGEMENT UNIT OF SECOND RECORDING AREA (16KB)
272 SECOND RECORDING AREA (64800KB=16KB×4050)
273 ADDRESS MANAGEMENT INFORMATION STORAGE SECTION (576KB=16KB×36)
27

Fig. 14

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LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE

LOGICAL ADDRESS	LOGICAL ADDRESS (LOWER 5 BITS)							
	0	1	2	3	4	...	30	31
0~31	320	321	322	323	324		350	351
32~63	352	353	354	355	356		382	383
64~95	384	385	386	387	388		414	415
96~127	416	417	418	419	420		446	447
128~159	-	-	-	-	-	...	-	-
160~191	-	-	-	-	-		-	-
192~223	-	-	-	-	-		-	-
224~255	-	-	-	-	-		-	-

53

LINK TABLE

PHYSICAL ADDRESS	PHYSICAL ADDRESS (LOWER 5 BITS)								
	0	1	2	3	4	...	30	31	
0~31	11	11	11	11	11		11	11	FOR FIRST RECORDING AREA
32~63	11	11	11	11	11		11	11	
64~95	11	11	11	11	11		11	11	
⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	
320~351	00	00	00	00	00	...	00	00	FOR SECOND RECORDING AREA
352~383	00	00	00	00	00		00	00	
384~415	00	00	00	00	00		00	00	
416~447	00	00	00	00	00		00	00	
448~479	11	11	11	11	11		11	11	

00:VALID BLOCK
11:INVALID BLOCK (ERASED)
10:INVALID BLOCK (NOT ERASED)

Fig. 15A

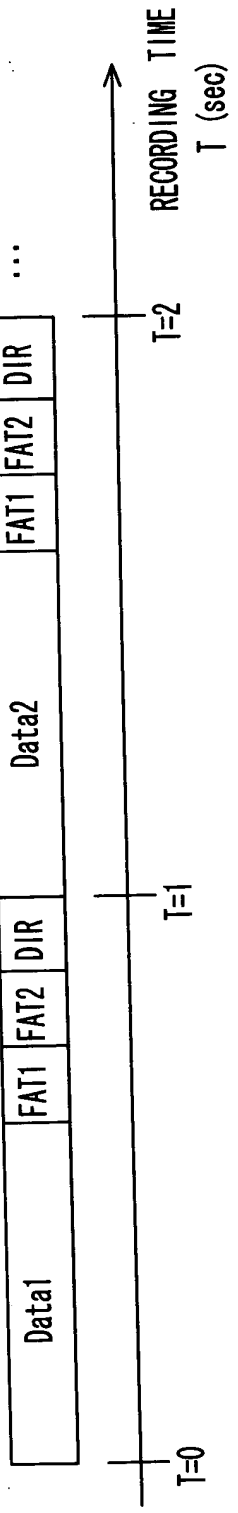
Data1
FAT1
FAT2
DIR
Data2
FAT1
FAT2
DIR
...
T=0
T=1
T=2
RECORDING TIME
T (sec)

Fig. 15B

Seq.	COMMAND SEQUENCE
1	SET POSITION INFORMATION OF FILE SYSTEM MANAGEMENT INFORMATION (FAT1):SetFSInfoAddr(addr=32, size=1)
2	SET POSITION INFORMATION OF FILE SYSTEM MANAGEMENT INFORMATION (FAT2):SetFSInfoAddr(addr=34, size=1)
3	SET POSITION INFORMATION OF FILE SYSTEM MANAGEMENT INFORMATION (DIR):SetFSInfoAddr(addr=64, size=1)
4	WRITE 16KB OF DATA:Write(addr=128, size=32)
5	WRITE FAT1:Write(addr=32, size=1)
6	WRITE FAT2:Write(addr=34, size=1)
7	WRITE DIR:Write(addr=64, size=1)
8	WRITE 16KB OF DATA:Write(addr=160, size=32)
9	WRITE FAT1:Write(addr=32, size=1)
10	WRITE FAT2:Write(addr=34, size=1)
11	WRITE DIR:Write(addr=64, size=1)
12	AFTERWARD, WRITE SIMILARLY FAT1, FAT2, AND DIR REPEATEDLY

Fig.16

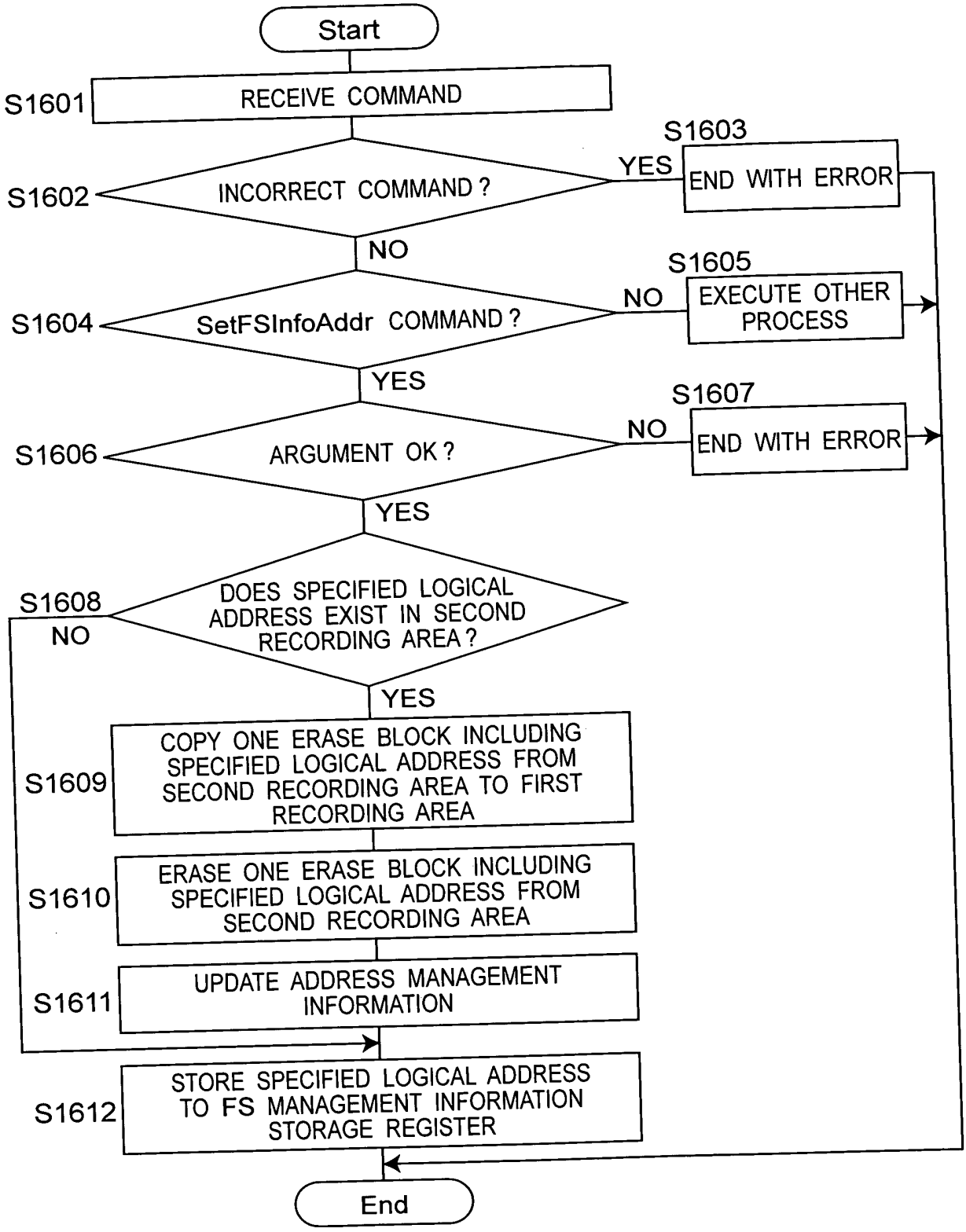
Start
S1601
RECEIVE COMMAND
S1602
INCORRECT COMMAND ?
YES
S1603
END WITH ERROR
NO
S1604
SetFSInfoAddr COMMAND ?
NO
S1605
EXECUTE OTHER PROCESS
YES
S1606
ARGUMENT OK ?
NO
S1607
END WITH ERROR
YES
S1608
DOES SPECIFIED LOGICAL ADDRESS EXIST IN SECOND RECORDING AREA ?
NO
YES
S1609
COPY ONE ERASE BLOCK INCLUDING SPECIFIED LOGICAL ADDRESS FROM SECOND RECORDING AREA TO FIRST RECORDING AREA
S1610
ERASE ONE ERASE BLOCK INCLUDING SPECIFIED LOGICAL ADDRESS FROM SECOND RECORDING AREA
S1611
UPDATE ADDRESS MANAGEMENT INFORMATION
S1612
STORE SPECIFIED LOGICAL ADDRESS TO FS MANAGEMENT INFORMATION STORAGE REGISTER
End

Fig.17

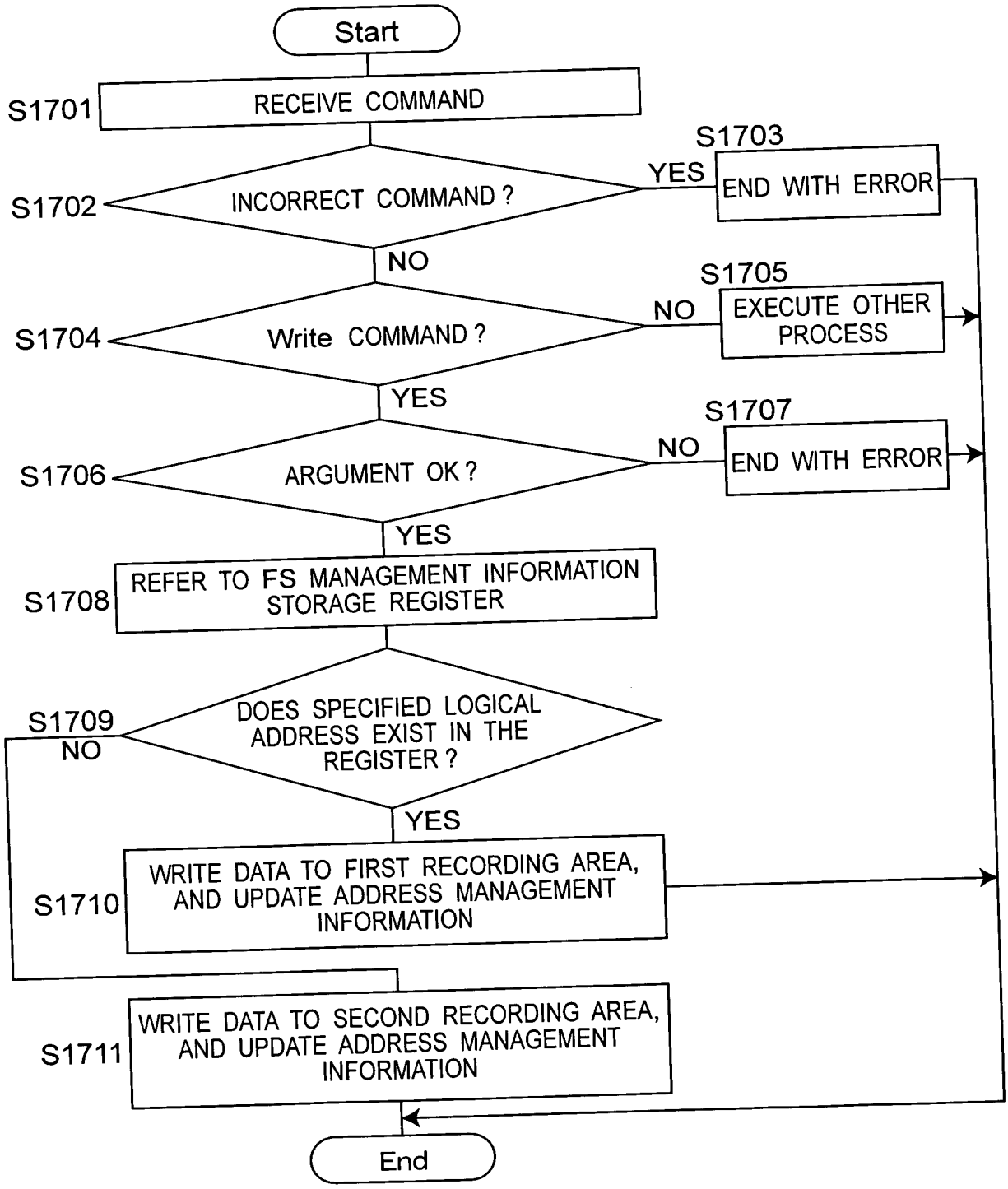
Start
S1701
RECEIVE COMMAND
S1702
INCORRECT COMMAND ?
YES
S1703
END WITH ERROR
NO
S1704
Write COMMAND ?
NO
S1705
EXECUTE OTHER PROCESS
YES
S1706
ARGUMENT OK ?
NO
S1707
END WITH ERROR
YES
S1708
REFER TO FS MANAGEMENT INFORMATION STORAGE REGISTER
S1709
DOES SPECIFIED LOGICAL ADDRESS EXIST IN THE REGISTER ?
NO
YES
S1710
WRITE DATA TO FIRST RECORDING AREA, AND UPDATE ADDRESS MANAGEMENT INFORMATION
S1711
WRITE DATA TO SECOND RECORDING AREA, AND UPDATE ADDRESS MANAGEMENT INFORMATION
End

Fig. 18

51 LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE

LOGICAL ADDRESS	LOGICAL ADDRESS (LOWER 5 BITS)							
	0	1	2	3	4	...	30	31
0~31	320	321	322	323	324		350	351
32~63	0	1	2	3	4		30	31
64~95	32	33	34	35	36		62	63
96~127	416	417	418	419	420		446	447
128~159	-	-	-	-	-	...	-	-
160~191	-	-	-	-	-		-	-
192~223	-	-	-	-	-		-	-
224~255	-	-	-	-	-		-	-

53 LINK TABLE

PHYSICAL ADDRESS	PHYSICAL ADDRESS (LOWER 5 BITS)								
	0	1	2	3	4	...	30	31	
0~31	00	00	00	00	00		00	00	FOR FIRST RECORDING AREA
32~63	00	00	00	00	00		00	00	
64~95	11	11	11	11	11		11	11	
⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	
320~351	00	00	00	00	00	...	00	00	FOR SECOND RECORDING AREA
352~383	11	11	11	11	11		11	11	
384~415	11	11	11	11	11		11	11	
416~447	00	00	00	00	00		00	00	
448~479	11	11	11	11	11		11	11	

Fig. 19

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LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE

LOGICAL ADDRESS	LOGICAL ADDRESS (LOWER 5 BITS)							
	0	1	2	3	4	...	30	31
0~31	320	321	322	323	324		350	351
32~63	0	1	2	3	4		30	31
64~95	32	33	34	35	36		62	63
96~127	416	417	418	419	420		446	447
128~159	352	353	354	355	356	...	382	383
160~191	-	-	-	-	-		-	-
192~223	-	-	-	-	-		-	-
224~255	-	-	-	-	-		-	-

53

LINK TABLE

PHYSICAL ADDRESS	PHYSICAL ADDRESS (LOWER 5 BITS)								
	0	1	2	3	4	...	30	31	
0~31	00	00	00	00	00		00	00	FOR FIRST RECORDING AREA
32~63	00	00	00	00	00		00	00	
64~95	11	11	11	11	11		11	11	
⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	
320~351	00	00	00	00	00		00	00	FOR SECOND RECORDING AREA
352~383	00	00	00	00	00	...	00	00	
384~415	11	11	11	11	11		11	11	
416~447	00	00	00	00	00		00	00	
448~479	11	11	11	11	11		11	11	

Fig. 20

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LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE

LOGICAL ADDRESS	LOGICAL ADDRESS (LOWER 5 BITS)							
	0	1	2	3	4	...	30	31
0~31	320	321	322	323	324		350	351
32~63	64	1	65	3	4		30	31
64~95	66	33	34	35	36		62	63
96~127	416	417	418	419	420		446	447
128~159	352	353	354	355	356	...	382	383
160~191	-	-	-	-	-		-	-
192~223	-	-	-	-	-		-	-
224~255	-	-	-	-	-		-	-

53

LINK TABLE

PHYSICAL ADDRESS	PHYSICAL ADDRESS (LOWER 5 BITS)								
	0	1	2	3	4	...	30	31	
0~31	10	00	10	00	00		00	00	FOR FIRST RECORDING AREA
32~63	10	00	00	00	00		00	00	
64~95	00	00	00	11	11		11	11	
⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	
320~351	00	00	00	00	00	...	00	00	FOR SECOND RECORDING AREA
352~383	00	00	00	00	00		00	00	
384~415	11	11	11	11	11		11	11	
416~447	00	00	00	00	00		00	00	
448~479	11	11	11	11	11		11	11	

Fig. 21

51 LOGICAL-PHYSICAL ADDRESS CONVERSION TABLE

LOGICAL ADDRESS	LOGICAL ADDRESS (LOWER 5 BITS)							
	0	1	2	3	4	...	30	31
0~31	320	321	322	323	324		350	351
32~63	64	1	65	3	4		30	31
64~95	66	33	34	35	36		62	63
96~127	416	417	418	419	420		446	447
128~159	352	353	354	355	356		382	383
160~191	384	385	386	387	388	...	414	415
192~223	-	-	-	-	-		-	-
224~255	-	-	-	-	-		-	-

53 LINK TABLE

PHYSICAL ADDRESS	PHYSICAL ADDRESS (LOWER 5 BITS)								
	0	1	2	3	4	...	30	31	
0~31	10	00	10	00	00		00	00	FOR FIRST RECORDING AREA
32~63	10	00	00	00	00		00	00	
64~95	00	00	00	11	11		11	11	
⋮	⋮	⋮	⋮	⋮	⋮		⋮	⋮	
320~351	00	00	00	00	00		00	00	FOR SECOND RECORDING AREA
352~383	00	00	00	00	00	...	00	00	
384~415	00	00	00	00	00		00	00	
416~447	00	00	00	00	00		00	00	
448~479	11	11	11	11	11		11	11	